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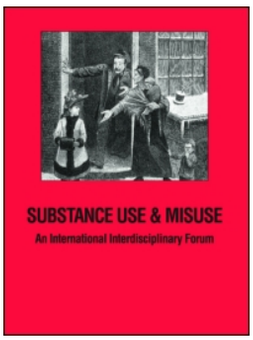

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ORIGINAL ARTICLE

Electronic Cigarette Use and Associated Risk Factors in U.S.-Dwelling Pacific Islander Young Adults

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ABSTRACT

Background: E-cigarette use is rapidly increasing among US young adults, heightening their risk for vaping-related illnesses. Yet, little is known about e-cigarette use among young adult Native Hawaiians and Pacific Islanders (NHPI): an indigenous-colonized US racial group rarely described in research literature. This exploratory study provides the first known data on e-cigarette use and potential risk factors in NHPI young adults. *Method:* Self-report data were collected from 143 NHPI young adults (age 18–30 years) living in two large NHPI communities: Samoans in urban Los Angeles County and Marshallese in rural Arkansas. We assessed rates of e-cigarette, cigarette, alcohol, and marijuana use, and positive and negative outcome expectancies from e-cigarettes, that is expected outcomes from e-cigarette use. To identify potential risk factors for NHPI e-cigarette use, regressions explored associations between participants' current e-cigarette use with current cigarette, alcohol, and marijuana use, and e-cigarette outcome expectancies. *Results:* Among NHPI young adults, lifetime e-cigarette use rate was 53% and current use rate was 39%. Current rate of dual e-cigarette/cigarette, e-cigarette/alcohol, and e-cigarette/marijuana use was 38%, 35%, and 25%, respectively. In our regression models, current marijuana use and positive e-cigarette outcome expectancies were significantly associated with current e-cigarette use. *Conclusions:* E-cigarette use is common among NHPI young adults, exceeding rates for other at-risk racial groups. Marijuana use and positive expectations about e-cigarette use may represent potential e-cigarette use risk factors. Collectively, findings underscore the need for additional research to further explore the scope of, and risk and protective factors for, e-cigarette use in this understudied high-risk population.

KEYWORDS

E-cigarettes; Native Hawaiians and Pacific Islanders; e-cigarette outcome expectancies

Introduction

In the US, e-cigarette use has increased dramatically, particularly among young adults, who possess the nation's heaviest rates of e-cigarette use (Hu et al., 2016; Schulenberg et al., 2019). Although widely perceived as safer than cigarettes (Pearson et al., 2012), emerging research suggests that e-cigarettes pose a significant threat to public health as they have been linked to the expression of numerous chronic diseases such as asthma, pulmonary disorder, heart disease, and cancer (Glantz & Bareham, 2018; Schweitzer et al., 2017; Wills et al., 2019), as well as oxidative damage to DNA (Sakamaki-Ching et al., 2020). In addition to affecting users' long-term health, recent evidence has associated e-cigarette use with severe immediate harms such as vaping-related lung injury/disease (Christiani, 2020; Layden et al., 2020) that have resulted in an increasing number of vaping-related deaths (CDC, 2019). Because young adults have primarily borne the brunt of outbreaks of vaping-related illness and death (CDC, 2019; Perrine et al., 2019), e-cigarettes' increasing popularity and potentially lethal consequences have placed young adults – particularly those with specific risk profiles including belonging to known at-risk racial groups such as Whites and Latina/os (USHHS, 2016) – at the forefront of this growing public health crisis.

Unfortunately, despite this crisis, little is known about e-cigarette use in young adults from indigenous/colonized US racial populations. This is especially true for Native Hawaiians and Pacific Islanders (NHPIs): a rapidly growing US racial group persistently understudied in extant literature. Due to their exposure to heavy US colonization and historical trauma (Kaholokula, 2007; Yamada, 2004), NHPIs are affected by myriad health disparities (McElfish et al., 2015; Mishra et al., 1996) including vulnerability to substance use; underscoring the need to investigate e-cigarette use and its relationships to other commonly used substances in NHPIs.

For instance, US data from the National Surveys on Drug Use and Health revealed that in 2011, NHPIs aged ≥12 years had substantially greater prevalence vs. Whites aged ≥12 years of illicit/non-medical drug use (21.2% vs. 15.1%), particularly with respect to marijuana use (18.8% vs. 11.3%)

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(Wu et al., 2013). Similarly, a national study of 25 years of Centers for Disease Control and Prevention Youth Risk Behavior Survey data (Subica & Wu, 2018) indicated that NHPI adolescents reported significantly higher prevalence of lifetime substance use compared to White adolescents for many illicit substances including marijuana (42.1% vs. 38.5%), cocaine (11.0% vs. 7.0%), methamphetamines (9.0% vs. 6.1%), and heroin (8.2% vs. 2.2%). With regard to alcohol use, NHPI adolescents also reported the highest lifetime prevalence of pre-adolescent alcohol use (30.3%) and heavy episodic drinking (27.5%) of all US racial groups (Subica & Wu, 2018). In addition, prior studies of Native Hawaiian adolescents uncovered the highest rates of alcohol use, chronic drinking, and heavy episodic drinking of all racial/ethnic groups in Hawai'i (Klingle & Miller, 1999; Nishimura et al., 2005).

These elevated rates of substance use likely place NHPI young adults at heightened risk for e-cigarette use. Of particular concern are NHPIs' elevated prevalence of conventional cigarette use as NHPI adults have been shown to have increased rates of cigarette smoking (Martell et al., 2016) – an established e-cigarette risk factor (Chapman & Wu, 2014) – compared to other US racial groups. This heightened e-cigarette risk is most apparent in a recent dataset where NHPI adults reported higher prevalence of e-cigarette use (5.6%) vs. African Americans (2.1%) and Latinas/os (2.2%) (Narcisse et al., 2020).

Further compounding NHPIs' heightened e-cigarette risk is their disproportionate exposure to aggressive tobacco marketing (Muggli et al., 2002) with current data indicating e-cigarette marketing exposure positively predicted e-cigarette use among college students in Hawaii (Pokhrel et al., 2018a) – the state with the nation's largest proportion of NHPIs. However, the few existing e-cigarette studies that have included NHPI young adults as part of their samples have primarily sampled college students (Pokhrel et al., 2014). This may potentially limit current knowledge of NHPI young adult e-cigarette use as only 47% of NHPI adults attend college vs. 55% of the general population (Teranishi et al., 2019) with 50–58% of NHPIs who attend college dropping out (Espinosa et al., 2017). Accordingly, only 19% of NHPIs complete four-year college (Ramakrishnan & Ahmad, 2014).

Thus, to capture a better understanding of e-cigarette use among NHPI young adults, we conducted the first known investigation of e-cigarette use among community-dwelling NHPI young adults. To identify potential e-cigarette risk factors affecting this population, we examined their (1) co-occurring use of conventional cigarettes, alcohol, and marijuana, the three most commonly used substances (Schulenberg et al., 2019); and (2) positive and negative e-cigarette outcome expectancies (i.e. expected outcomes from a behavior), as outcome expectancies are an important antecedent for substance use (Pokhrel et al., 2014) and have predicted e-cigarette use in prior studies (e.g. Brikmanis et al., 2017; Pokhrel et al., 2018a, 2018b).

Finally, because NHPIs compose a heterogeneous racial population consisting of numerous NHPI subgroups (Hixson et al., 2015), we examined NHPI young adults from two highly divergent NHPI subgroups living on the continental US to enhance generalizability. These were urban Samoans living in Los Angeles County and rural Marshallese living in Northwest Arkansas, who represent the second-largest and fastest-growing US NHPI subgroups, respectively (US Census Bureau, 2010). We chose these two subgroups because their stark differences in settings (urban West Coast vs. the rural South), country of origin (US territory vs. foreign nation), and language (Samoan vs. Marshallese) would greatly strengthen the generalizability of our study findings while simultaneously allowing us to explore the similarities and differences in e-cigarette use and e-cigarette risk factors between two disparate NHPI young adult populations.

Methods

Participants and recruitment

Study protocols received approval from the University of California, Riverside IRB. Trained NHPI research staff collected self-administered survey data between May and November 2019 from NHPI young adults in the urban Samoan community in Los Angeles County, California and the rural Marshallese in Northwest Arkansas as these are the largest and fastest growing continental US NHPI communities, respectively (US Census, 2010). Inclusion criteria were age 18–30 years, full or part-Samoan or Marshallese heritage, and living in our target NHPI communities. The main exclusion criterion was lack of English reading and writing fluency (as determined by staff during the informed consent process). Participants were recruited using a non-probabilistic, respondent-driven sampling approach (Mays & Pope, 1995) used to capture representative community samples in earlier NHPI studies (Subica et al., 2019a, 2019b). This involved NHPI staff recruiting participants directly from diverse community settings where NHPI young adults congregate (e.g. recreational centers, community-based organizations), and also through social media outreach. Informed consent and surveys were conducted by staff in person as self-report survey or over the phone as an interview with participants receiving $20.

Measures

Demographics and e-cigarette use

Study demographic variables were age, gender, NHPI ethnicity (Samoan, Marshallese), education level, and marital status. As in earlier studies (Pokhrel et al., 2018a, 2018b), ever e-cigarette use was assessed by asking "*Have you ever used any type of e-cigarette or similar vaping device (e.g. Juul)*?" and current e-cigarette use (i.e. use in the past month) was determined by responses of "Daily," "Less than daily, but at least once per week," or "Less than weekly, but at least once per month" to "*How often, if at all, do you currently use an e-cigarette or similar vaping device*?" Number of days e-cigarettes were used in the past month were measured by

Table 1. Sample characteristics and descriptive statistics.

Variables	Total sample		Men		Women		Samoan		Marshallese	
	%	*n*	%	*n*	%	*n*	%	*n*	%	*n*
Formal education										
<High school	16	22	18	16	11	6	4	2	23	20
High school graduate	55	76	53**	46	56	30	45	23	61	53
College and higher	29	40	25	22	33	18	51**	26	16	14
Marital status										
Single	80	107	84	69	75	38	67	32	88	75
Married/living as married	20	26	16	13	25	13	33	16	12	10
E-cigarette use										
Ever use e-cigarettes	53	76	53	47	53	29	71**	37	43	39
Currently use e-cigarettes	39	55	41	46	35	19	40	21	37	34
Other substance use										
Currently use cigarettes	54	77	63**	55	40	22	62	32	49	45
Currently use alcohol	79	113	85*	75	69	38	79	41	79	72
Currently use marijuana	39	56	45	40	29	16	42	22	37	34
	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD
E-cigarette expectancies										
Positive expectancies	4.39	2.90	4.56	3.02	4.09	2.68	5.78**	1.71	3.57	3.14
Popular	3.60	3.35	3.64	3.44	3.53	3.20	5.50**	2.60	2.51	3.25
Relaxed	5.11	3.36	5.13	3.45	5.08	3.25	6.98**	1.87	4.05	3.56
Enjoy vaping	4.58	3.38	4.83	3.44	4.15	3.25	5.92**	2.55	3.82	3.56
Smells good	4.15	3.24	4.44	3.40	3.65	2.90	4.73	2.30	3.82	3.63
Negative expectancies	4.10	2.89	3.90	3.04	4.46	2.58	6.01**	1.28	3.03	2.99
Hurts lungs	4.44	3.43	4.13	3.57	5.00	3.13	6.21**	2.17	3.45	3.62
Awkward	3.59	3.04	3.39	3.11	3.96	2.91	4.81**	2.18	2.90	3.25
Become addicted	4.59	3.76	4.55	3.85	4.65	3.62	7.19**	2.65	3.12	3.49
Bad taste	4.35	2.28	3.54	3.25	4.19	3.04	5.69**	1.94	2.69	3.24

**Significant difference at .01 level between participants by gender or Pacific Islander ethnicity.
*Significant difference at .05 level between participants by gender or Pacific Islander ethnicity.

asking, "*during the past 30 days, on how many days did you use e-cigarettes or similar vaping device?*" These three e-cigarette items (Pokhrel et al., 2018b) collectively produced excellent internal consistency with a Cronbach's α of 0.92.

Current cigarette, alcohol, and marijuana use

Current conventional cigarette use was determined by responses of "Some days" or "Every day" to "*Do you now smoke cigarettes every day, some days, or not at all*?" (Pokhrel et al., 2014). Current alcohol use was defined as any positive response (excluding "Never") to the Alcohol Use Disorders Identification Test-Concise (AUDIT-C; Bush et al., 1998) item querying "*How often do you have a drink containing alcohol*?" (Response options: "Never," "Monthly or less," "2–4 times a month," "2–3 times per week," "4 or more times a week"). Current marijuana use was operationalized as any days of reported use in the past month to the item "*During the past 30 days, on how many days did you use marijuana, hashish, or another THC product*?"

E-cigarette outcome expectancies

E-cigarette outcome expectancies were assessed *via* validated 8-item Young Adult E-Cigarette Outcome Expectancy scale (Pokhrel et al., 2018b). This scale asked participants to rate on a 0–9 scale the likelihood (0 = *unlikely*, 9 = *likely*) that they would experience four positive outcomes (i.e. *more popular, feel relaxed, enjoy vaping, smell good*) and four negative outcomes (i.e. *hurt lungs, look awkward, become addicted, bad taste*). Composite positive and negative expectancy scores were generated by taking the mean of the four positive and four negative outcome items, respectively (Pokhrel et al., 2018b). These four positive and four negative expectancy outcome items possessed strong internal consistencies with Cronbach's α of 0.89 and 0.88, respectively.

Statistical analyses

We analyzed data in SPSS v.24 (IBM, 2014) with descriptive statistics producing variable frequencies, means, standard deviations, and 95% confidence intervals. Chi-square and independent *t*-tests examined significant gender differences. We ran two hierarchical logistic regression (outcome variables = ever e-cigarette use and current e-cigarette use, respectively) and one linear regression model (outcome variable = number of days e-cigarettes used in past 30 days). Independent variables were demographics of age, gender, NHPI ethnicity, education, and marital status, and current use of cigarettes, alcohol, and marijuana entered in Step 1, and mean positive and negative e-cigarette outcome expectancies scores entered in Step 2 to determine whether outcome expectancies associated with e-cigarette use above and beyond Step 1 variables. To compare pseudo coefficients of determination in the logistic models, we used Nagelkerke's R^2 (Nagelkerke, 1991).

Results

Participants characteristics and use of E-cigarettes, cigarettes, alcohol, and marijuana

Participants' educational and marital status characteristics, as well as frequencies of e-cigarette and other relevant substance use by gender and NHPI ethnicity are presented in

Table 2. Associations of e-cigarette ever use, current use, and days of use by current substance use and positive and negative e-cigarette outcome expectancies.

	DV = Ever used e-cigarettes			DV = Current e-cigarette use			DV = # Days of e-cigarette use	
Variables	AOR	95% CI	Pseudo R^2 (ΔR^2)	AOR	95% CI	Pseudo R^2 (ΔR^2)	β	R^2 (ΔR^2)
Step 1								
Demographic								
Age	1.02	0.90–1.17	0.38	0.99	0.87–1.13	0.35	−0.04	0.29
Gender: Men	1.19	0.32–4.38		2.58	0.73–9.10		0.22	
PI ethnicity: Samoan	2.03	0.55–7.53		0.31	0.08–1.17		0.21	
Formal education: Less than high school								
High school graduate	1.63	0.41–6.56		1.40	0.35–5.58		−0.05	
College or higher	2.26	0.38–13.37		0.96	0.17–5.31		−0.10	
Marital status: Single	3.71	0.67–20.57		1.93	0.49–7.64		0.01	
Substance use								
Currently use cigarettes	1.96	0.62–6.18		1.06	0.33–3.41		0.03	
Currently use alcohol	2.96	0.63–13.92		0.93	0.17–5.18		0.03	
Currently use marijuana	5.54**	1.84–16.73		8.79**	2.89–26.75		0.38**	
Step 2								
Demographic								
Age	1.01	0.87–1.18	0.55 (0.17)	0.97	0.85–1.12	0.45 (0.10)	−0.02	0.42 (0.13)
Gender: Men	0.84	0.17–4.12		2.50	0.63–9.92		0.16	
PI ethnicity: Samoan	0.77	0.16–3.85		0.18**	0.04–0.77		0.14	
Formal education: Less than high school								
High school graduate	1.57	0.31–7.95		1.18	0.25–5.55		−0.09	
College or higher	2.08	0.28–15.70		0.65	0.10–4.17		−0.19	
Marital status: Single	4.65	0.69–31.25		2.13	0.51–8.79		0.02	
Substance use								
Currently use cigarettes	1.35	0.35–5.15		0.79	0.21–2.95		−0.04	
Currently use alcohol	3.06	0.48–19.44		0.81	0.11–5.94		−0.08	
Currently use marijuana	2.99	0.76–11.80		6.21**	1.74–22.18		0.34**	
E-cigarette expectancies								
Positive expectancies	1.57**	1.18–2.11		1.43**	1.10–1.87		0.50**	
Negative expectancies	1.07	0.81–1.43		0.99	0.75–1.30		−0.17	

DV, dependent variable; AOR, adjusted odds ratio; CI, confidence interval; β, standardized regression coefficient; Pseudo R^2, Nagelkerke R^2; ΔR^2, change in R^2 between Step 1 and Step 2.
**$p < .01$.

Table 1. Of the 143 total NHPI participants ($M_{age} \pm$ SD = 23.6 years ± 4.1 years; range = 18–30 years), 61.5% were men, 63.6% were of Marshallese ethnicity, and 80.5% reported single marital status. Consistent with prior research suggesting low levels of college attendance and completion among NHPI young adults, only 29.0% of participants reported attending college and only eight total participants (5.6%) reported completing college with significant differences in educational status between Samoan and Marshallese participants ($X^2(1, N = 141) = 28.1$, $p \leq .01$).

Regarding e-cigarette use, 53.1% of NHPI participants reported ever e-cigarette use and 38.5% reported current e-cigarette use (i.e. use in the past month). On average, participants used e-cigarettes in 6.0 of the past 30 days. With regard to other substance use, 53.8% of participants reported current cigarette use, 79.0% reported current alcohol use, and 39.2% reported current marijuana use. Men were significantly more likely to report currently using cigarettes ($X^2(1, N = 132) = 10.31$, $p \leq .01$) and alcohol ($X^2(1, N = 143) = 5.32$, $p \leq .05$), but not e-cigarettes or marijuana. Similarly, Samoan participants were significantly more likely to report ever using e-cigarettes ($X^2(1, N = 143) = 10.64$, $p \leq .01$), but demonstrated no significant differences from Marshallese participants in rates of current e-cigarette, cigarette, alcohol, or marijuana use. Dual use of e-cigarettes among participants was: 28.0% ($n = 40$) with conventional cigarettes; 35.0% with alcohol ($n = 50$); and 25.2% with marijuana ($n = 36$), accounting for 51.9%, 44.2%, and 64.3% of all current cigarette, alcohol, and marijuana users, respectively.

E-cigarette outcome expectancies

Among participants, the most strongly endorsed positive outcomes were "feeling relaxed" and "enjoying smoking" with a mean positive outcome expectancy score of 4.4. The most strongly endorsed negative outcomes were "becoming addicted to e-cigarettes," "hurting lungs," and "having a bad taste" with a mean negative outcome expectancy score of 4.1.

Although no significant gender differences were identified in mean positive and negative expectancies scores on any item, significant differences were noted between Samoan and Marshallese participants (see Table 1). Specifically, Samoan participants reported significantly higher mean scores than Marshallese participants ($p \leq .01$) for every queried positive expectancy item (e.g. become popular, feel relaxed) and negative expectancy item (e.g. hurts lungs, become addicted) with the exception of the "smell good" positive expectancy item.

Regressions of ever, current, and number of days of e-cigarette use

For the "ever e-cigarette use" logistic model, in Step 1, current marijuana use associated with 5.5 times ($p \leq .01$)

greater likelihood of ever using e-cigarettes. When composite positive and negative outcome expectancies were included in Step 2, only positive expectancies significantly associated with ever e-cigarette use with a 1-point increase in mean positive expectancies score predicting 1.6 times ($p \leq .01$) greater likelihood of ever using e-cigarettes.

In the "current e-cigarette use" logistic model, in Step 1, current marijuana use associated with 8.8 times ($p \leq .01$) greater likelihood of current e-cigarette use. In Step 2, current marijuana use associated with 6.2 times ($p \leq .01$) greater likelihood of current e-cigarette use while a 1-point increase in mean positive expectancies score associated with 1.4 times ($p \leq .01$) greater likelihood.

For the "number of days e-cigarettes used" linear regression model, in Step 1, currently using marijuana significantly associated with greater number of days e-cigarettes were used ($p \leq .01$) while in Step 2, current marijuana use and mean positive expectancies score significantly associated with greater number of days e-cigarettes were used ($p \leq .01$). Please see Table 2 for all model results.

Discussion

To our knowledge, this is the first study to directly investigate e-cigarette use in NHPI communities, generating novel insights regarding the scope of e-cigarette use in this understudied indigenous/colonized racial population. Study findings indicated that over 50% of NHPI young adults (18–30 years) had ever used e-cigarettes, exceeding the young adult lifetime e-cigarette use rates reported for other high-risk US racial groups. These reported rates include 37% for Latina/o young adults, 40% for White young adults, and 44% for Asian American young adults, with African American young adults reporting the lowest rates of any racial group at 23% (USHHS, 2016; Maglalang et al., 2016). Approximately four in 10 NHPI young adults reported currently using e-cigarettes, nearly three times the 13.6% rate of current e-cigarette use for US young adults aged 18–24 years, and over six times the 5.8% rate for US young adults aged 25–30 years (USHHS, 2016). Therefore, relative to their peers, our results revealed substantial e-cigarette use disparities in NHPI young adults, increasing their risk for vaping-related illness and harm.

Consistent with earlier research finding strong associations between the use of conventional cigarettes and e-cigarettes (Chapman & Wu, 2014; Dutra & Glantz, 2014), dual use was common among NHPI young adults, with over half of current cigarette users concurrently using e-cigarettes. But when current cigarette use was examined as a potential e-cigarette use risk factor in our regression models, after adjusting for current alcohol and marijuana use, current cigarette use did not associate with any of our e-cigarette use variables. Instead, current marijuana use showed the strongest substance-related association with e-cigarette use in our sample, associating with six times greater likelihood for current e-cigarette use after accounting for participants' cigarette and alcohol use, and e-cigarette outcome expectancies. Accordingly, using marijuana may be a more potent e-cigarette risk factor in NHPI young adults than conventional cigarettes; a theory bolstered by our added finding that 64% of current marijuana users also used e-cigarettes. Further research is now needed to elucidate the reasons for this marijuana/e-cigarette relationship, such as NHPIs potentially using e-cigarettes to vape marijuana (Giroud et al., 2015).

In particular, our finding of a strong marijuana–e-cigarette relationship among NHPI young adults may have significant implications for understanding and thus reducing the elevated e-cigarette use found in our study. In extant data, NHPIs use marijuana at significantly higher rates than non-NHPIs (Wu et al., 2013; Wu & Blazer, 2015), particularly at younger ages such as pre-adolescence and adolescence (Subica & Wu, 2018) when individuals appear to be most vulnerable to initiating e-cigarette use (Chapman & Wu, 2014). Therefore, to limit e-cigarette use and related harms in NHPI young adults, researchers should consider studying and monitoring NHPIs' marijuana and e-cigarette use starting in pre-adolescence to better discern the source of this relationship, and its implications for promoting and sustaining NHPIs' e-cigarette use over time.

Additionally, study data revealed that holding positive expectations about the outcomes of e-cigarette use (e.g. using e-cigarettes will increase relaxation) significantly associated with all e-cigarette use variables. These findings closely align with prior research indicating that positive expectations about e-cigarette use represent a significant e-cigarette risk factor in young adults (Brikmanis et al., 2017; Pokhrel et al., 2014, 2018a, 2018b). Consequently, one potential avenue for reducing NHPI young adults' e-cigarette risk may be through challenging their positive expectations surrounding e-cigarette use using evidence-based approaches. Or, if current approaches prove ineffective, by designing and implementing culturally adapted/grounded intervention approaches for NHPIs (Okamoto et al., 2014).

In comparing our two NHPI subgroups, Samoan and Marshallese participants were similar in terms of demographics (with the exception of Samoan young adults having higher rates of college or higher education) and current use of all examined substances (e.g. e-cigarettes, marijuana). However, Samoan participants reported higher rates of ever using e-cigarettes than Marshallese participants (71% vs. 43%), although this difference disappeared when examining rates of current e-cigarette use. Thus, Marshallese individuals may be less likely to try e-cigarettes but more likely to persist in using e-cigarettes into young adulthood than their Samoan counterparts.

Lastly, Samoan participants reported higher levels for nearly all positive and negative e-cigarette outcome expectancies vs. Marshallese participants, which may indicate greater awareness/exposure among Samoan young adults to e-cigarettes and/or e-cigarette marketing (Pokhrel et al., 2018a). Possible explanations for this pattern that could be explored in future research include potentially (1) greater access to, or penetration of, e-cigarettes in urban Los Angeles County NHPI vs. rural Arkansas NHPI communities; (2) greater susceptibility of Samoan young adults to e-cigarette messaging/marketing (Mantey et al., 2016); or (3)

greater US acculturation among Samoans vs. Marshallese, as shown in prior research (Subica et al., 2019b).

Several study limitations are noted. First, employing a non-probabilistic community sampling approach, while empirically supported for assessing hard-to-reach populations (Alvarez et al., 2006), may have impacted study generalizability. In addition, although we assessed several important demographic variables as controls for our regressions, we did not assess all possible demographic variables such as income, employment status, and parental educational level. Future research should consider further assessing the influence of these and other potentially relevant demographic variables on NHPI young adults' e-cigarette use. Also, because substance use underreporting is common in minority samples (Johnson & Bowman, 2003), utilizing self-report data may have introduced biasing into results. However, given the extreme scarcity of NHPI e-cigarette use data, even with some biasing our exploratory results are notable and contribute important information that enhances our knowledge of NHPI e-cigarette use. Finally, as this study focused on quantifying e-cigarette use, follow-up qualitative research should be conducted with diverse NHPI communities to illuminate the specific underlying factors driving NHPI young adults' elevated use.

Collectively, our novel findings are among the first to describe a concerning pattern of e-cigarette use among NHPI young adults, and highlight potential pathways for reducing their e-cigarette risk. While further research is required, curtailing NHPI e-cigarette use may require developing culturally tailored prevention interventions to address their unique cultural risk and protective factors (Castro & Alarcon, 2002) by applying culturally grounded participatory approaches to bolster intervention feasibility and effectiveness (Okamoto et al., 2014) for this overlooked and underserved racial population.

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Declaration of interest

The authors have no interests to disclose.

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